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BIBLIOMETRIC ANALYSIS OF SCIENTIFIC PUBLICATIONS IN THE FIELD OF ONLINE EDUCATION*

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Online learning has become a necessity for students in Ukraine since the beginning of the pandemic and then the full-scale invasion of Ukraine by the Russian Federation. The development of online education and the creation of effective tools for its implementation are becoming relevant. A significant number of teachers and students have gone abroad for evacuation, and therefore the distance format is the most acceptable for them. In order to avoid significant losses in knowledge acquisition due to the war, it is necessary to develop online education and create appropriate initial content. The article presents the results of a bibliometric analysis of a number of scientific publications on online education that were published in the "pre- and post-conflict" periods (2014–2018 and 2019–2023, respectively). The purpose of the study is to examine the conceptual apparatus of the term "Online Education" in the context of 5 years before and after the COVID-19 pandemic. To conduct the analysis, the authors used such bibliometric tools as VOSviewer and Bibexcel. Based on the results of the bibliometric analysis, the authors created a graphical visualization and cluster distribution of the conceptual apparatus (including interrelationships). The LinLog/modularity normalization method was used to build the network visualization. The most cited publications of certain time periods were analyzed. Thus, there has been a sharp increase in the publication activity of scientists on the topic of online learning and online education since 2019. Conclusions have been drawn about current trends in online education related to the global pandemic. When building the visualization clusters, four patterns were identified: the cluster components reflect the concepts of classical educational elements that have moved to the online environment; the main advantages of online education and tools that make it accessible to users; elements of the online learning process and their features; the main methodology of online teaching, which is based on the use of massive open online courses and training videos on various platforms. Scientific research during the COVID-19 pandemic and developments in the field of distance learning technologies will become the basis for maintaining the educational process during the war in Ukraine. Studies in different countries show that the number of platforms and open primary courses that can be used by teachers and professors in teaching students is growing.

Keywords: online education, COVID-19 pandemic, clustering, normalization method, bibliometric analysis.

JEL Classification: I21, I28

Formulation of the problem. The economic development and competitiveness of a country is determined by the level of its intellectual capital and the degree of education of its citizens, who are able to use their potential for the benefit of the state. In recent years, the search for ways to continuously learn as learners, from preschool education to adult education, has become particularly important. Due to the COVID-19 pandemic, all educational institutions in Ukraine were forced to close

for quarantine, and many of them were unable to switch to online learning due to a lack of technology, facilities, and qualified teachers. However, online education has developed significantly during this period and has become widespread. With the outbreak of the full-scale Russian-Ukrainian war, the only way to keep the educational process going for students of secondary, vocational, and higher education was to use distance learning technologies and communication with the teacher.

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The study of scientific publications in the field of online education will help to identify new trends in this area, study the experience of other countries that have faced similar problems, and find ways to improve online learning in Ukraine. Currently, the education system is being reformed and the concept of state policy development in the field of education in Ukraine is being discussed, so this issue is quite relevant and urgent for study.

Analysis of recent research and publications. This research is based on information taken from the Scopus database [1]. We will use only open and verified data. The general search query is as follows: TITLE-ABS-KEY ("online education"). Below is a statistical graph of the number of publications related to the key term "online education" since 1980.

Based on Fig. 1, we can conclude that there has been a sharp increase in the publication activity of scientists on the topic of online learning and online education since 2019 (more than 2000 documents in 2022). We will analyze in more detail the factor influencing the growth in the number of publications on the studied topics by examining their trend and trends for the period of 5 years before the pandemic (2014–2018) and 5 years after (2019–2023).

Let's use the same Scopus database [1] to search for the required pool of publications using the keyword phrase "online education" in the period of 5 years before the COVID-19 pandemic (this pool will include publications indexed from 2014 to 2018 inclusive). The general search query is as follows: TITLE-ABS-KEY ("online education") AND (LIMIT-TO (PUBLICATION YEAR, 2018) OR LIMIT-TO (PUBLICATION YEAR, 2017) OR LIMIT-TO (PUBLICATION YEAR, 2016) OR LIMIT-TO (PUBLICATION YEAR, 2015) OR LIMIT-TO (PUBLICATION YEAR, 2014)).

The search returned 1896 documents. This sample will be sufficient to form a voluminous array of related concepts. General statistics for the selected publications are shown in Fig. 2.

The graph of changes in the number of publications is gradually increasing, with the number ranging from 324 (minimum in 2015) to 462 (maximum in 2018). The trend is steadily growing and does not reflect significant fluctuations.

Regarding the distribution of publications by field of knowledge, the vast majority of publications are in the social sciences (33.7%) and computer sciences (24.7%). This inclination towards these fields is logical and relevant to the concept of "online education".

The purpose of research. The purpose of this research article is to study the conceptual apparatus of the term "Online Education" in the context of 5 years before and after the COVID-19 pandemic. This study will be implemented using bibliometric tools such as VOSviewer and Bibexcel [2; 3]. A graphical visualization and cluster distribution of the conceptual apparatus (including interrelationships) will be formed. Conclusions will be drawn about current trends in online education related to the global pandemic. The most cited publications of these time periods will be analyzed.

Presentation of the main research material. For bibliographic analysis, we use the programs VOSviewer and Bibexcel. We process the .RIS file exported from the Scopus database, filter out the concepts that are redundant in content, and generate the following network visualization (Fig. 3).

The visualization resulted in 4 clusters, 35 elements, 587 links, and a total link strength of 8675. The normalization method used to build the graph is LinLog/modularity. This normalization method reflects the vast majority of

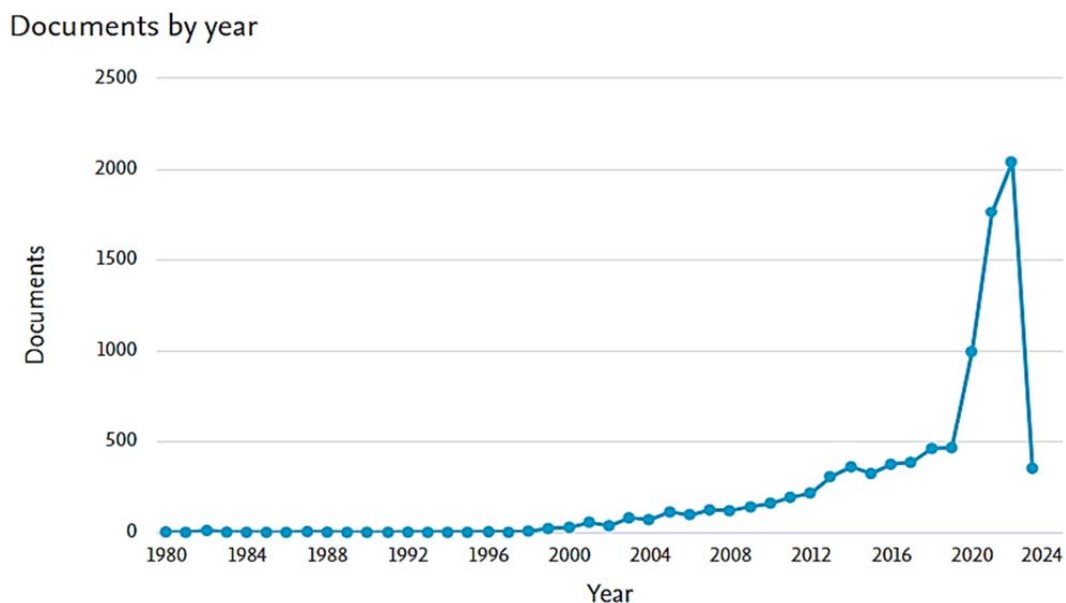


Figure 1 – The number of publications in the Scopus database for the key term "online education" since 1980 (accessed on 03/31/2022)

Source: compiled by the author based on the results of a search query in the Scopus database [1]

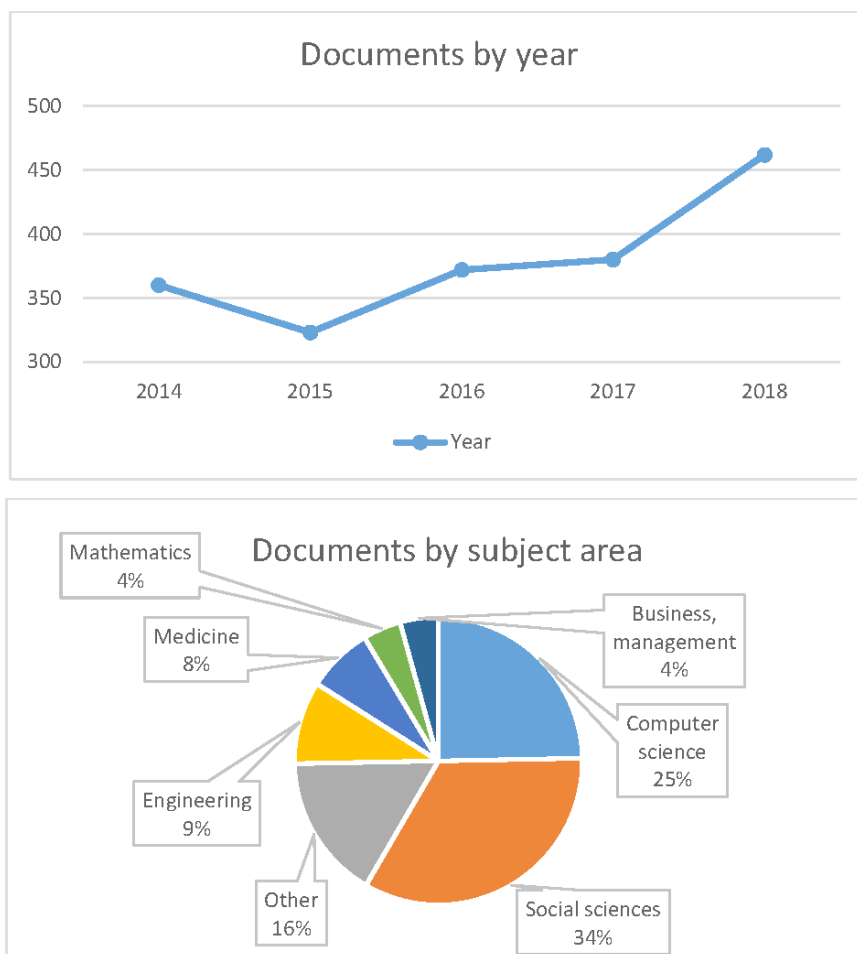


Figure 2 – Graph of the number of documents on the key concept of "online education" for the period from 2014 to 2018, and their distribution by field of knowledge (accessed on 31.03.2022)

Source: compiled by the author based on the results of a search query in the Scopus database [1]

links and components that are ordered by the density of mentions (from the center to the edges of the visualization map). The graph (Fig. 3) shows 3 main large clusters with more than 8 elements: red, green, and blue. The yellow cluster consists of 4 concepts, 2 of which are identical in meaning (massive open online courses = moocs).

All the concepts within the clusters are united in meaning and occur within the same publications. To determine the specific patterns of cluster formation based on the results of visualization, let's build Table 1.

Based on the results of Table 1, the following assumptions can be made about the sample of publications with the key term "online education" from 2014 to 2018 [4–7]:

Publications of this period include the concept of classical educational elements that have moved to the online environment. Any online education is, first of all, classical educational components in the prism of the Internet and distance learning.

The analyzed sample of publications focuses on the differences and advantages of online education compared

to the "live" format. First of all, the emphasis is on the accessibility of this type of education.

The main methodology of online teaching is based on the use of massive open online courses and training videos on various platforms.

By analogy with the previous sample of publications of the "pre-covid" period, we will select a sample of publications of the "post-covid" period with input data from the Scopus database for the period from 2019 to 2023, the search query is TITLE-ABS-KEY ("online education") AND (LIMIT-TO (PUBLICATION YEAR, 2023) OR LIMIT-TO (PUBLICATION YEAR, 2022) OR LIMIT-TO (PUBLICATION YEAR, 2021) OR LIMIT-TO (PUBLICATION YEAR, 2020) OR LIMIT-TO (PUBLICATION YEAR, 2019)).

According to the search results, 5695 documents were found, which is 60.79% of the total result of the search query "online education" – 9367 documents. Such a large number of publications over the past 5 years indicates the extreme relevance of the chosen topic. General statistics on the selected publications are presented in Fig. 4.

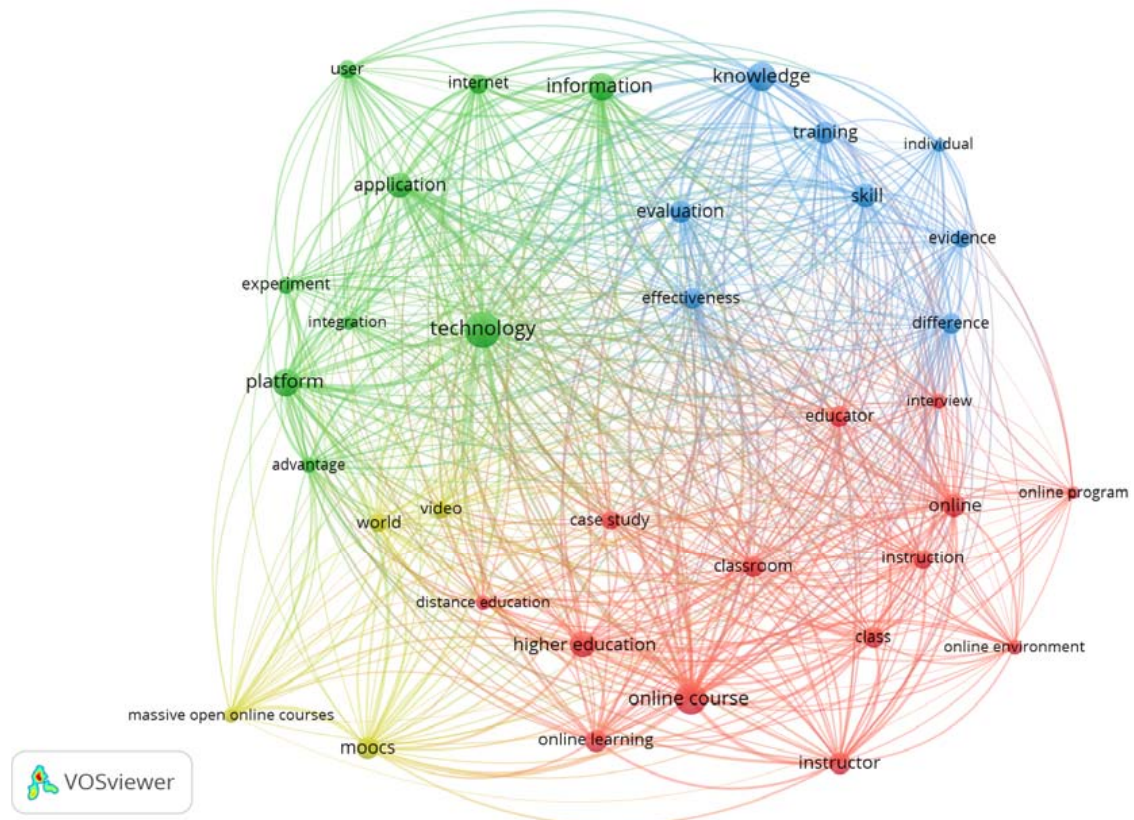


Figure 3 – Network visualization of the term "online education" in the period from 2014 to 2018 (inclusive) (accessed on 31.03.2022)

Source: created by the author using the VOSviewer software based on the results of a search query in the Scopus database

Table 1 – Patterns of cluster formation based on the results of visualization (Fig. 3)

№	Color	Cluster components	Patterns of cluster formation
1	Red	case study, class, classroom, distance education, educator, higher education, instructor, instructor, interview, online, online course, online environment, online learning, online program.	The components of the cluster reflect the concepts of classical educational elements that have moved to the online environment.
2	Green	Advantage, application, experiment, information, integration, internet, platform, technology, user.	The cluster components reflect the main advantages of online education and the tools that make it accessible to users.
3	Blue	Difference, effectiveness, evaluation, evidence, individual, knowledge, skill, training.	The cluster components reflect the elements of the online learning process and their features.
4	Yellow	massive open online courses, moocs, video, world.	The components of the cluster reflect the main methodology of online teaching, which is based on the use of massive open online courses and training videos on various platforms.

Source: compiled by the authors

The graph of changes in the number of publications is rapidly growing (in 2023, only data for the 1st quarter are taken into account). Regarding the distribution of publications by field of knowledge, the percentage distribution by subject has expanded. The shares of social sciences (from 33.7% to 26.6%) and computer sciences (from 24.7% to 22.3%) decreased. The share of publications in the medical field increased accordingly (7.1%). This growth in the latter is due to the direct impact of the global pandemic on the development of online education.

By analogy with Fig. 3, we will use the same programs VOSviewer and Bibexcel to find relationships between related concepts. The resulting network visualization is as follows (Fig. 5).

As a result of the visualization, 4 clusters were formed, which include 29 elements. The normalization method used to build the graph is LinLog/modularity. The visualization graph (Fig. 5) shows 3 main large clusters with more than 8 elements – red, green and blue. The yellow cluster consists of 3 concepts that fully reflect

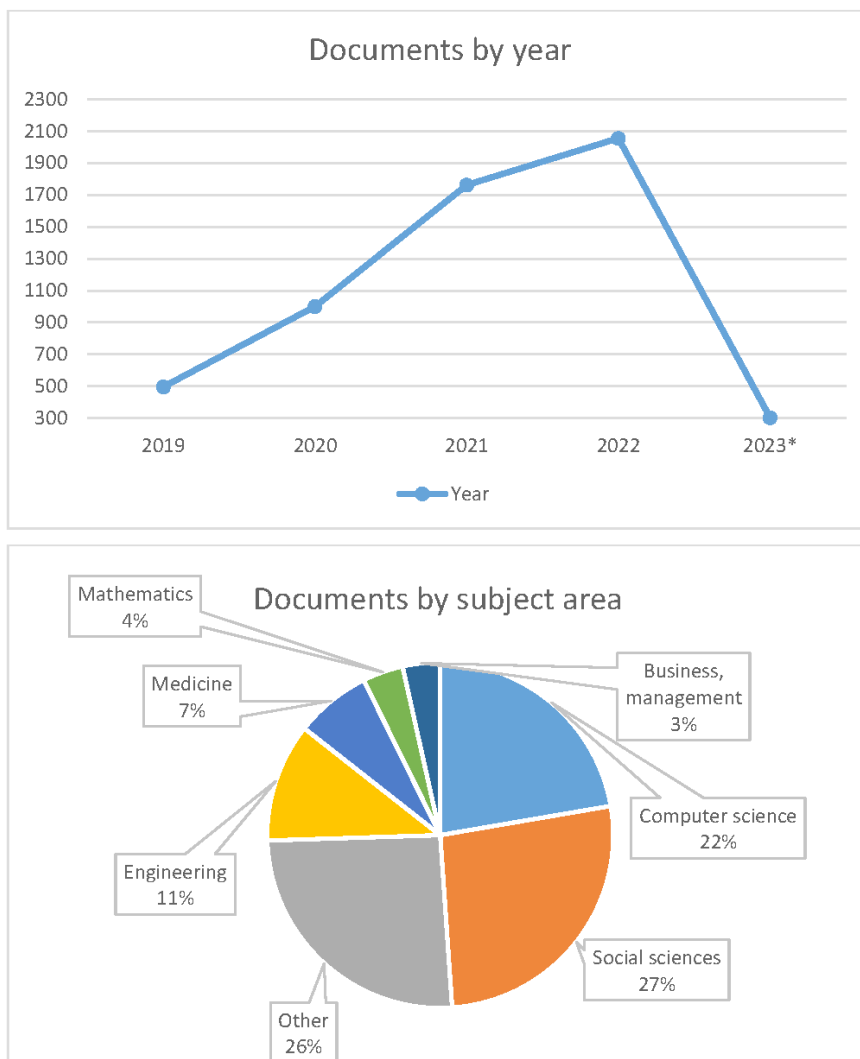


Figure 4 – Graph of the number of documents on the key concept of "online education" for the period from 2019 to 2023, and their distribution by field of knowledge (accessed on 31.03.2022)

Source: compiled by the author based on the results of a search query in the Scopus database [1]

Table 2 – Patterns of cluster formation based on the results of visualization (Fig. 5)

№	Color	Cluster components	Patterns of cluster formation
1	Red	class, covid, educational institution, lecture, lockdown, online class, online survey, pandemic, students' perception, university student.	The formation of the cluster is based on the impact of COVID-19 on higher and secondary education institutions and their online work during the pandemic.
2	Green	feedback, internet, moocs, online course, online environment, researcher, technology, user.	The cluster is based on the use of online courses, online learning, and research in the online environment.
3	Blue	coronavirus disease, crisis, design methodology approach, education system, educator, higher education institution, online teaching, originality value.	The principles of formation of this cluster of concepts are very similar to cluster 1. They reflect the basics of the functioning of educational systems during the pandemic and the development of new methodological approaches to online education.
4	Yellow	Distance, distance education, distance learning.	The cluster is based on the use of distance learning and distance education technologies in all areas.

Source: compiled by the authors

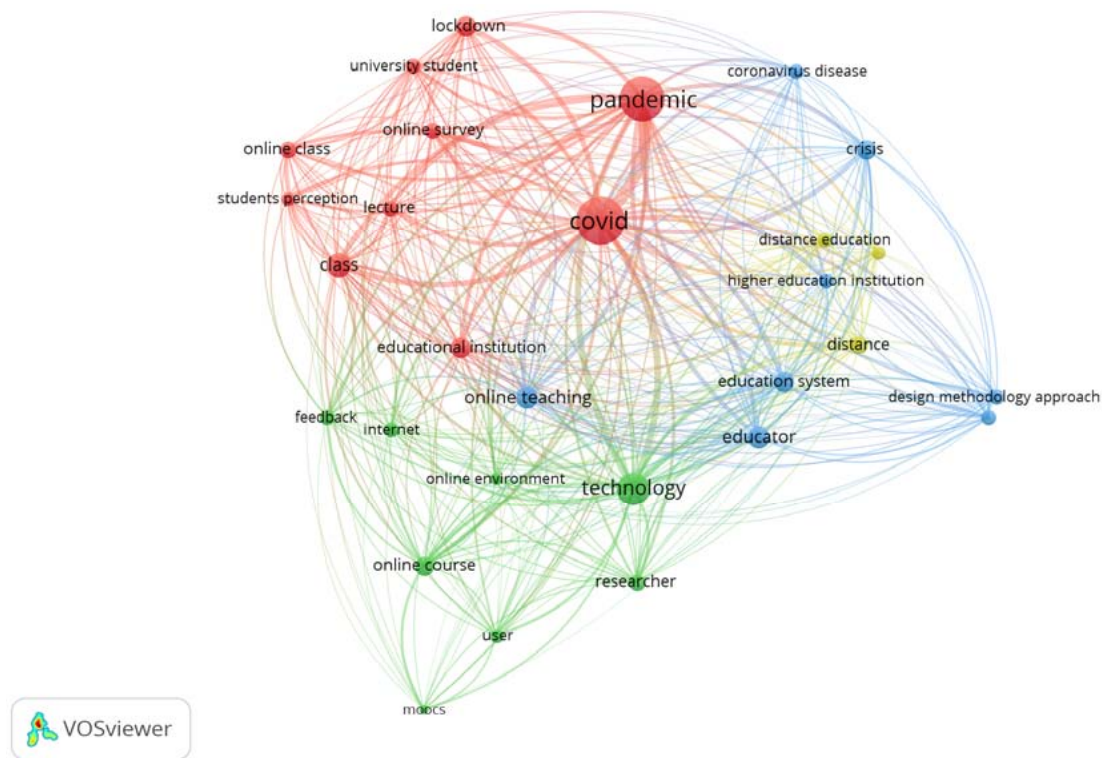


Figure 5 – Network visualization of the term "online education" in the period from 2019 to 2023 (inclusive) (accessed on 31.03.2022)

Source: created by the author using the VOSviewer software based on the results of a search query in the Scopus database [1]

the distance nature of online education. All the concepts within the clusters are united in meaning and occur within the same publications. To determine the specific patterns of cluster formation based on the results of visualization, let's build Table 2.

Compared to the conclusions drawn from the analysis in Table 2, the following can be assumed:

- the array of publications that were published in the period from 2019 to 2023 includes the impact of the COVID-19 pandemic factor on all spheres of public life;
- the topic of online education has become extremely popular since 2019, when it became necessary to develop new teaching methods and transform the educational process [8];
- "remote relations" in all industries have also affected the field of education, which has gradually switched to a fully remote format (including research);
- the COVID-19 pandemic has given a huge impetus to the development of the latest online educational platforms and changed the focus of research in this area [9–12].

Conclusion. After analyzing the cross-sections of publications in the Scopus database of the "pre-covid" and "post-covid" periods (2014–2018 and 2019–2023), we concluded that the pandemic has changed the priority of the "online education" area. Massive online courses have begun to develop around the world, and both secondary and higher education institutions have begun to develop their own educational platforms as part of distance education. Society has realized that despite the pandemic danger, the educational process cannot be stopped. This has given a new impetus to certain fields of science, online research, and the development of Internet technologies. The developments during the COVID-19 pandemic and developments in the field of distance learning technologies will become the basis for maintaining the educational process during the war in Ukraine. Further areas of research include determining the prospects for the development of online education in Ukraine and the world, searching for best practices and tools for its implementation to preserve the country's intellectual capital and ensure its economic growth.

REFERENCES:

1. Database Scopus. Available at: <https://www.scopus.com/> (accessed 31.03.2023).
2. Van Eck N., & Waltman L. (2010) Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, no. 84(2), pp. 523–538. Available at: <https://link.springer.com/article/10.1007/s11192-009-0146-3> (accessed 31.03.2023).
3. Persson O., Danell R., & Schneider, J. W. (2009) How to use Bibexcel for various types of bibliometric analysis. *Celebrating scholarly communication studies: A Festschrift for Olle Persson at his 60th Birthday*, no. 5, pp. 9–24. Available at: <http://umu.diva-portal.org/smash/record.jsf?pid=diva2%3A232746&dswid=-4226> (accessed 31.03.2022).
4. Jordan K. (2014) Initial trends in enrolment and completion of massive open online courses. *International Review of Research in Open and Distributed Learning*, no. 15(1), pp. 133–160.

5. Kuo Y.C., Walker A.E., Schroder K.E., & Belland B.R. (2014) Interaction, Internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses. *The internet and higher education*, no. 20, pp. 35–50. DOI: <https://doi.org/10.1016/j.iheduc.2013.10.001> (accessed 31.03.2022).
6. Dumford A.D., & Miller A.L. (2018) Online learning in higher education: exploring advantages and disadvantages for engagement. *Journal of computing in higher education*, no. 30, pp. 452–465. Available at: <https://link.springer.com/article/10.1007/s12528-018-9179-z> (accessed 31.03.2022).
7. Palvia S., Aeron P., Gupta P., Mahapatra D., Parida R., Rosner R., & Sindhi S. (2018) Online education: Worldwide status, challenges, trends, and implications. *Journal of Global Information Technology Management*, no. 21(4), pp. 233–241. DOI: <https://doi.org/10.1080/1097198X.2018.1542262> (accessed 31.03.2022).
8. Kotenko S.I. (2023) Modern methods of online learning and their use in educational institutions of Ukraine. March 2023 scientific discourse on the topic: "Determinants of strengthening the role of education in the post-war recovery of Ukraine". Collection of materials of the International Scientific and Practical Conference for Educators (Chernihiv, March 22, 2023). Chernihiv: NGO "Scientific and Educational Innovation Center for Social Transformations". 48–49. DOI: https://doi.org/10.54929/conf_ped_03_2023 (accessed 31.03.2022).
9. Bao W. (2020) COVID-19 and online teaching in higher education: A case study of Peking University. *Human behavior and emerging technologies*, 2(2), 113–115. Available at: <https://doi.org/10.1002/hbe2.191> (accessed 31.03.2022).
10. Mishra, L., Gupta, T., & Shree, A. (2020). Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. *International Journal of Educational Research Open*, no. 1. DOI: <https://doi.org/10.1016/j.ijedro.2020.100012> (accessed 31.03.2022).
11. Carrillo C., & Flores M.A. (2020) COVID-19 and teacher education: a literature review of online teaching and learning practices. *European journal of teacher education*, no. 43(4), pp. 466–487. DOI: <https://doi.org/10.1080/02619768.2020.1821184> (accessed 31.03.2022).
12. Muthuprasad T., Aiswarya S., Aditya K. S., & Jha G. K. (2021) Students' perception and preference for online education in India during COVID-19 pandemic. *Social sciences & humanities open*, no. 3(1). DOI: <https://doi.org/10.1016/j.ssaho.2020.100101> (accessed 31.03.2022).

БІБЛІОМЕТРИЧНИЙ АНАЛІЗ НАУКОВИХ ПУБЛІКАЦІЙ ЗА НАПРЯМОМ «ОНЛАЙН ОСВІТА»*

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Онлайн навчання стало вимушеним для здобувачів освіти в Україні з початком пандемії, а потім повномасштабним вторгненням Російської федерації на територію України. Актуальними стають питання розвитку онлайн освіти, створення ефективних інструментів її реалізації. Значна частина освітян та учнів виїхали за кордон в евакуацію і тому саме дистанційний формат є для них найбільш прийнятним. Аби уникнути значних втрат у здобутті знань через війну, потрібно розвивати саме онлайн освіту та формувати відповідний початковий контент. У статті представлено результати бібліометричного аналізу ряду наукових публікацій, присвячених онлайн освіті, які були опубліковані у «доковідний» та «післяковідний» періодів (2014–2018 рр. та 2019–2023 рр. відповідно). Метою дослідження є вивчення понятійного апарату терміну «Онлайн освіта» у розрізі 5 років до початку пандемії COVID-19 та після. Для проведення аналізу автори використали такі бібліометричні інструменти як VOSviewer та Bibexcel. За результатами проведеного бібліометричного аналізу авторами сформована графічна візуалізація та кластерний розподіл понятійного апарату (включно із взаємозв'язками). При побудові мережевої візуалізації було використано метод нормалізації LinLog/modularity. Проаналізовані найбільш цитовані публікації визначених часових періодів. Таким чином, відбулося різке зростання публікаційної активності науковців за тематикою онлайн навчання та онлайн освіти починаючи з 2019 року. Зроблені висновки щодо сучасних трендів в онлайн освіті, пов'язаних з глобальною пандемією. При побудові кластерів візуалізації було виявлено чотири закономірності: складові кластеру відображають поняття класичних освітніх елементів, які перейшли в онлайн-середовище; основні переваги онлайн-освіти та інструменти, які роблять її доступною для користувачів; елементи процесу онлайн-навчання та їх особливості; основну методичку онлайн-викладання, яка базується на використанні масових відкритих онлайн курсів та навчальних відео на різних платформах. Наукові дослідження за період пандемії COVID-19 і розробки у сфері дистанційних технологій навчання стали основою для збереження освітнього процесу в період війни в Україні. Як показують дослідження в різних країнах, зростає кількість платформ, відкритих початкових курсів, які можуть бути використані педагогами і викладачами під час навчання здобувачів освіти.

Ключові слова: онлайн освіта, пандемія COVID-19, кластеризація, метод нормалізації, бібліометричний аналіз.

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